Model Updating and Uncertainty Management for Aircraft Prognostic Systems, Phase I

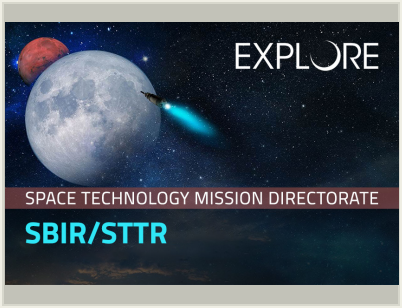
Completed Technology Project (2009 - 2009)

Project Introduction

This proposal addresses the integration of physics-based damage propagation models with diagnostic measures of current state of health in a mathematically rigorous method for the determination of remaining useful life. The principle goal of the proposed Phase I research is the investigation of issues associated with the integration of three independently developed algorithms (physics-based damage progression, diagnostics, and model updating architecture) in a single functioning system. Of particular interest is the ability of the proposed architecture to adequately represent the uncertainty associated with both diagnostic state estimation and loading conditions, and the propagation of such uncertainties to the remaining useful life prediction. The integrated prognostic system will be demonstrated using bearing damage (spallation) propagation models coupled with vibration derived diagnostic measures of spall severity obtained from in house testing. Following V&V of the baseline component-level prognostic system, extension of the existing technology towards support of subsystem-level (multi-model) prognostics will be pursued.

Anticipated Benefits

Potential NASA Commercial Applications: The proposed toolset will have extensive military and commercial applications. Again, any system that uses sensor-based diagnostics to indicate state and models to predict fault progression would benefit from the proposed toolset. Our vision for this technology is to develop a complete solution for most prognostics and health management applications, including the onboard framework and software components. System integrators or PHM/VHM developers will only need to add the application specific signal processing/diagnostics algorithms and fault progression model to rapidly assemble a complete prognostic capability. Sentient will strive to eventually make the architecture the de facto standard for prognostics by utilizing open interfaces, publishing all standards, and providing robust plug-and-play components. Aircraft and specifically propulsion systems are currently leading the way in implementation of new prognostic health monitoring technologies. Sentient is already working with the JSF program office, DARPA, and OEMs to develop new PHM technologies for this application.



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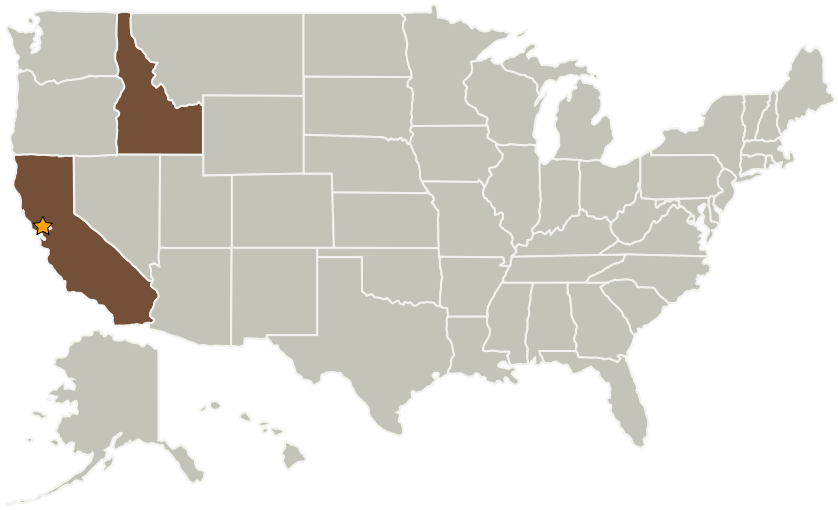
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Ames Research Center(ARC)	Lead Organization	NASA Center	Moffett Field, California
Sentient Corporation	Supporting Organization	Industry	Idaho Falls, Idaho

Primary U.S. Work Locations	
California	Idaho

Project Transitions

January 2009: Project Start

July 2009: Closed out

Closeout Summary: Model Updating and Uncertainty Management for Aircraft Prognostic Systems, Phase I Project Image

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Ames Research Center (ARC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

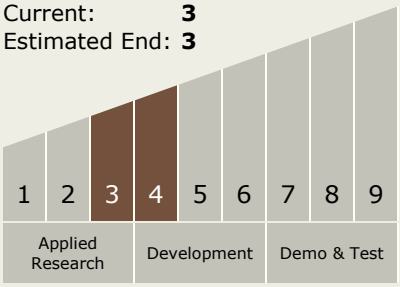
Carlos Torrez

Principal Investigator:

Nathan Bolander

Technology Maturity (TRL)

Start: **4**
Current: **3**
Estimated End: **3**



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Technology Areas

Primary:

- TX10 Autonomous Systems
  - TX10.2 Reasoning and Acting
    - TX10.2.5 Fault Diagnosis and Prognosis